Gateway to Arctic exploration

The trailer Gateway breaks through the Beaufort ice.

c'd: JUN 27 1984

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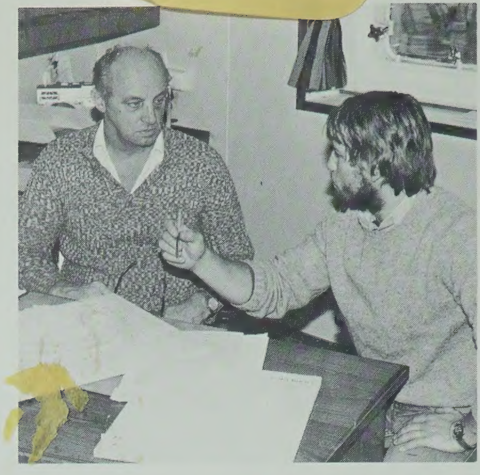
Caisson retained islands spearhead further Arctic exploration

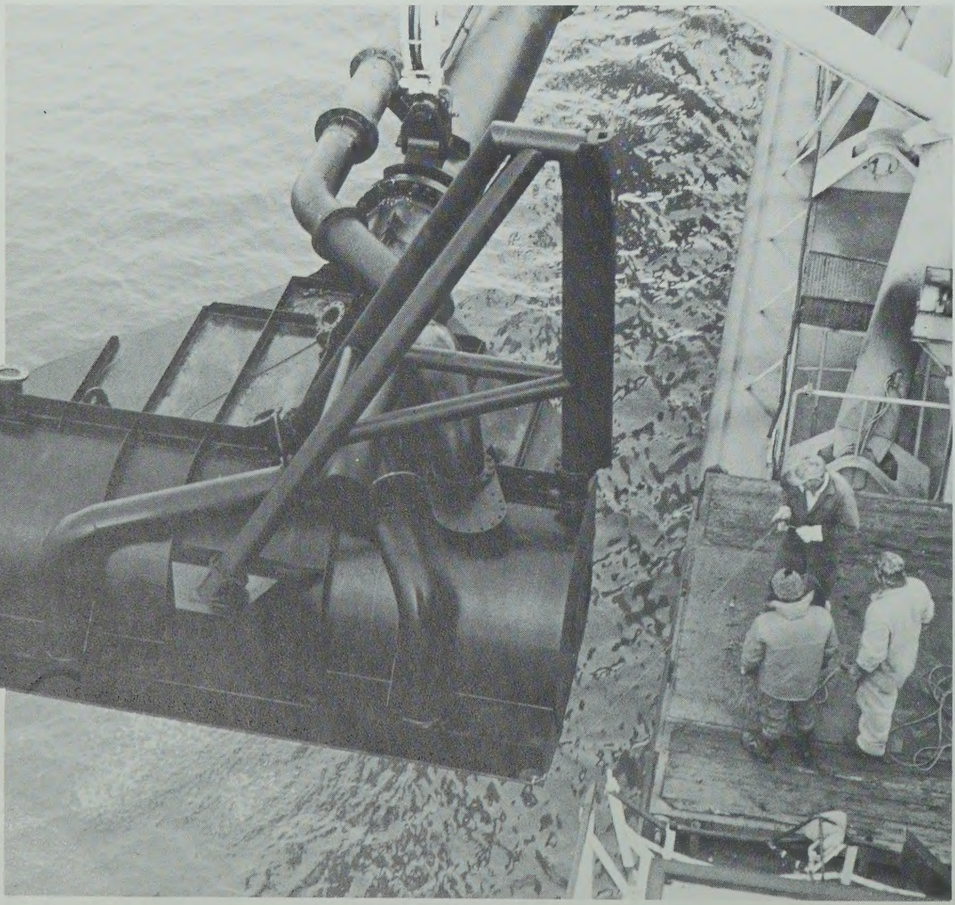
Trailer Gateway prepares for her second season



Cor Brakman (l), skipper of the Gateway, and Lynn Gregor, Esso's project engineer for the caisson, discuss progress with the aid of models which were made according to survey information.

These models help the site engineers to visualise how the berm is being built up.

Last year during the ice-free working season in Canada's Beaufort Sea, far north of the Arctic Circle, Beaver Dredging (Western) Limited of Toronto began construction of a series of Caisson-retained exploration islands in a five year contract awarded by Esso Resources Canada Ltd. The project demanded the mobilization and major refitment of the 6,000m^3 capacity WD Gateway which is now locked in the two metre thick Arctic ice, awaiting the summer thaw and the commencement in July of the 1983 work season. As Beaver crew members prepare to make their way north to de-winterise the dredger, Cohesion takes a look back at the progress made in 1982.



The dustpan suction head is lowered into the water.

Why CRI?

Beaver Dredging (Western)'s five year contract to construct caisson retained islands is an integral part of a more than $600 million exploration programme mounted by a group of Canadian hydrocarbon companies led by Home Oil Company Ltd. The agent for the group, with responsibility for the construction work and management of the activities, is Esso Resources Canada Ltd, an operating company of Imperial Oil Ltd.

The new exploration programme marks a significant step forward in the search for hydrocarbons in the Beaufort Sea. Over the past decade Esso has concentrated on the eastern sector of the Beaufort where two types of man-made islands have been constructed. These islands, which are capable of withstanding the immense pressures of the Arctic ice floes, act as drilling bases in place of conventional drilling vessels. Originally Esso built sandbag retained islands in the shallow waters close to shore. As the hunt for oil and gas moved further offshore, into deeper waters, a new type of island was favoured. To date seven of these islands have been constructed in water depths ranging from seven to 19 metres.

Known as sacrificial beach islands, they have all been built using sand dredged by the Beaver Mackenzie, a self-propelled suction dredger which has been working in the Arctic since 1976. The biggest sacrificial beach island that the Beaver Mac has constructed is Issungnak which took three seasons to build using some five million cubic metres of sand.

Esso's most promising hydrocarbon

discovery so far in the Beaufort was drilled from this giant man-made island in 1980. Sacrificial beach islands like Issungnak are economically viable where plentiful supplies of sand are available near the construction site. Now that Esso's exploration programme has extended into the western sector of the Beaufort Sea, where the seabed is predominently made up of clay and silt, this type of island cannot be built without hauling enormous quantities of sand over considerable distances of more than 100 kilometres. The cost involved in doing this would be excessive.

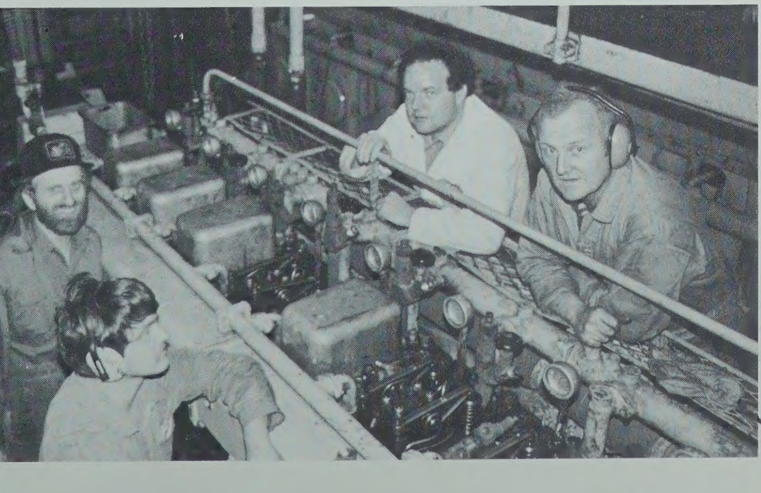
Aware of this problem as far back as 1975, Esso Resources Canada Ltd developed its third type of man-made island, the caisson retained island (CRI). This latest design utilises a steel caisson which is placed on a sand berm built up to eight metres below water level. Once in position on the berm, the caisson centre is then filled with sand to complete the island construction.

There are several advantages to this method, the foremost one being that considerably less sand is required. What sand is placed, because it is either well below the water surface or contained by the caisson, is not as prone to erosion and thus the island is relatively maintenance free. This is an important consideration in the Beaufort where fierce storms can quickly erupt causing extensive damage to the man-made islands, despite sand bagging and other slope protection measures. Winds of 60 knots per hour are not uncommon. The third advantage of the CRI is that the caisson is reusable.

The 12,000 tonnes steel caisson includes eight separate sections each 43m long, 13m thick at the base, eight metres thick at the top and 17 metres high. These separate sections are held together by a series of 76mm thick cables with a total length of five kilometres. When pieced together the segments form an octagonal structure more than 100 metres in diameter. Within the walls, which are angled to break up the surrounding ice, are sensors and other instrumentation designed to measure ice load pressures.

The caisson arrived at Esso's Tuktoyaktuk base last summer. It was shipped from Japan in sections on board a submersible pontoon. Upon arrival it was assembled to enable Esso personnel to familiarise themselves with the installation procedure, and then split into two sections prior to being allowed to freeze into the ice in Tuktoyaktuk Harbour. Later this year when the ice melts the caisson sections will be towed from Tuktoyaktuk Harbour, the winter mooring, and reassembled on the lip of the Beaufort Sea, ready for final positioning offshore on the pre-built berm.

Above: WD Gateway on location in the Beaufort Sea during the 1982 summer work season. Right: material is pumped through the dredger's self-discharging pipe which was installed in Japan. Other major modifications were also carried out.



Above left: provisions are brought aboard the Gateway by one of the helicopters which operate out of Tuktoyaktuk, Esso's base. Left: pictured in the Gateway's engine room are (l - r): Ian Liddell (wearing cap) 1st engineer; Gerrit Groenewegen, engineer; John Hines, superintendent engineer; and Kees Hoogland, chief engineer.

Gateway's role

The location of the first CRI will be Kadluk, located about 100 kilometres west of Tuktoyaktuk. Here during the 1982 work season from mid-July to mid-October the WD Gateway built the underwater sand berm and stockpiled sufficient sand to fill the caisson when it is placed. In addition to this the Gateway carried out various other tasks including the partial construction of a second berm.

In readiness for her five year term in the Beaufort Sea, the Gateway was given a major overhaul and prepared for Arctic operations. Modifications were carried out in a Japanese shipyard while the ship was en route to the Beaufort Sea from work in Australia. Refitment included the installation of a helipad, ice strengthening of the bow, the addition of a self-discharging system, and the installation of a soils analysis laboratory, etc. To help avoid expensive dry-docking periods in the Beaufort Sea, the Gateway's propellers were also modified to enable them to be removed underwater.

The self-discharging system, similar to that on the Boskalis Westminster pump ashore trailer WD Tideway, enables the Gateway to deposit sand into the upper part of the

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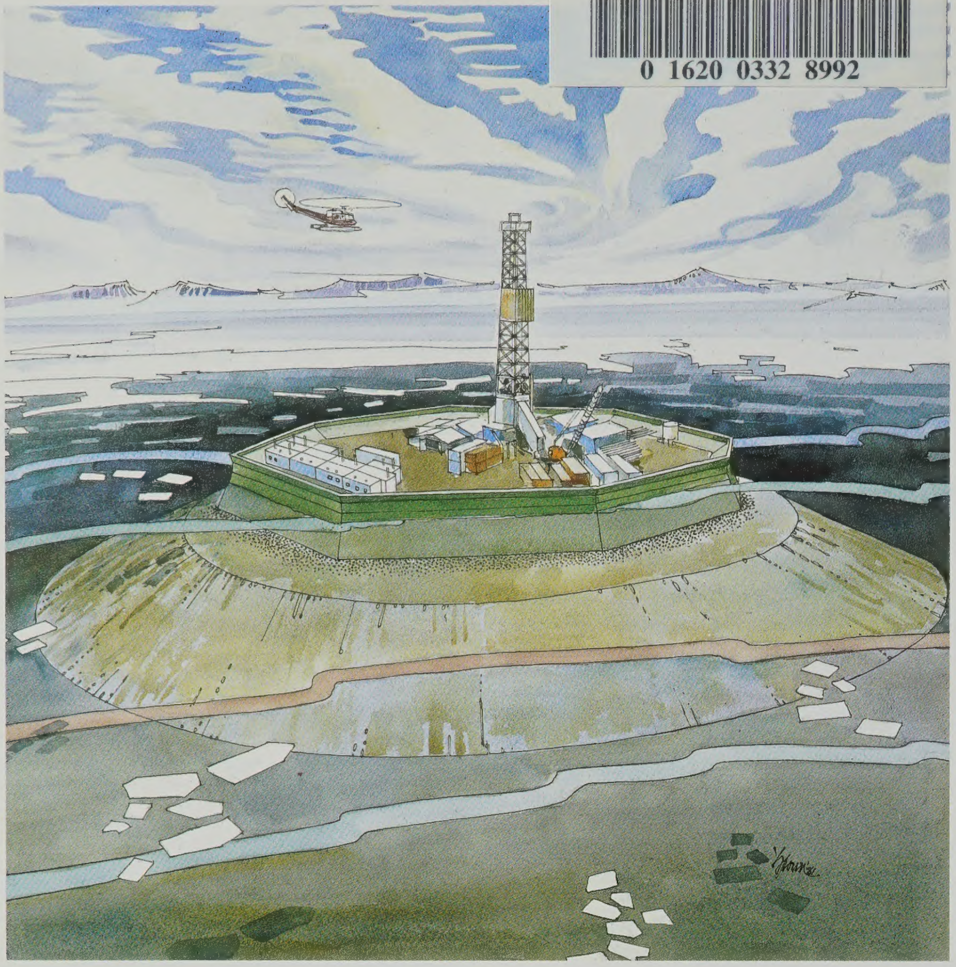

berm. Prior to conversion the dredger could only dump through her twenty bottom doors in a minimum water depth of about 12 metres. With the self-discharging apparatus, the Gateway can now deposit sand in shallower water and, with the use of a floating pipeline, she is able to pump material directly into the caisson.

The vessel's anchor system was also modified, enabling the Gateway to winch herself forwards along a given line by paying out the aft anchor wires and taking up the slack of the forward anchor chains. The purpose of this facility is to enable the Gateway to level the top of the berm to within a tolerance of 30 centimetres. This is essential to ensure that the steel caisson rests squarely and firmly on the berm.

For the actual levelling the Gateway has with her in the Beaufort a pair of dustpan heads which can be fitted to the dredger's suction arms in place of the conventional dragheads. These special dustpans incorporate water jets for dispersing and flattening the sand. Part of the 1982 dredging season was devoted to carrying out trials with this new anchoring and profiling technique.

With the modifications complete, the Gateway set sail from Japan on 11 July, 1982, arriving in the Canadian Beaufort Sea sixteen days later. With her she brought a range of spare parts, including several dragheads. A 350m long floating pipeline was delivered to Tuk from Canadian suppliers. Some of the spares on board the Gateway were offloaded and taken to Tuk, and the rest remained on board.

A few days later the Gateway commenced construction of the sand berm at Kadluk. Located in 13.5 metres water depth, the berm required the placement of 400,000m^3 of sand. A further 200,000m^3 was stockpiled alongside the berm and this is available to be pumped into the caisson when it is placed later this year. The sand was hauled to Kadluk from a borrow pit (called Ukalerk) sited more than 100 kilometres away. With the capability of sailing at 16 knots when fully laden, the Gateway was able to complete two return trips to the borrow pit every 24 hours.

To ensure that the Gateway has sufficient water in which to operate, the berm was built-up methodically in layers, beginning on one side of the berm and gradually working backwards. It has a bottom diameter of 350 metres and a top diamete of 170 metres, with side slopes of 1:15.

In addition to constructing the Kadluk berm, the Gateway also managed to construct part of a second berm at Minuk positioned about 25 kilometres away. Further supplies of sand were dumped elsewhere during the 1982 season to assi sister ship Beaver Mackenzie in the construction of a sacrificial beach island a a location known as Itiyok. Here the Beav Mac has built an island in 13.5 metres water depth using over two million cubic metres of fill material. The Gateway dumped sand directly onto the island and into the Beaver Mac's borrow pit, located directly behind the vessel, for topping off the island. Itiyok also provided Esso with a suitable test site at which to try out the caisson loading arm (constructed onto the deck of the support barge Kamatec) which will be connected to the Gateway's floating pipeline to take the sand up the caisson wall and into the centre of the island.

Future Programme

This coming season in the Beaufort Sea, the Gateway will continue to construct sand berms. It will be an important season for Esso and Beaver Dredging (Western) Ltd as the caisson will be place and filled for the first time.

After the Kadluk CRI island has been drilled next winter the well will be abandoned and the caisson moved to the next berm. This will be the pattern for the next four years. Esso anticipates constructing further retained islands durin this period in water depths ranging from 1 to 25 metres.

Above: artist's impression of the berm and caisson.

Below: the Beaver Ma (out of camera) at work last year.